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## **THE MEDICAL UNITY OF THE MEDITERRANEAN WORLD IN ANTIQUITY AND THE MIDDLE AGES**

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*A Lecture Delivered  
At the First Mediterranean Medical Meeting  
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## FORWORD

*It is a great pleasure for me to introduce this significant contribution to Mediterranean medical history by Professor Speros Vryonis, Jr., which was delivered as the opening lecture at the First Mediterranean Medical Meeting held in Herakleion, Crete, on September 24–29, 1989. The meeting was organized by the new Medical School of the University of Crete with the purpose of bringing physicians of the region together so as to get to know one another and thus have an opportunity to discuss common problems and share experiences in solving them.*

*Countries around the Mediterranean Sea, linked historically and culturally, also share social attitudes, needs and problems that influence medicine both in practice as well as in education and research. Crete was considered a suitable place, historically and geographically, for the First Mediterranean Medical Meeting, which was attended by many distinguished doctors from many Mediterranean as well as other countries. Important aspects of medical education and health-care systems in the Mediterranean countries were reviewed, and a special discussion gave birth to the Mediterranean Medical Society, with the aim of promoting co-operation amongst physicians and other health workers in the Mediterranean countries in addressing problems of mutual interest.*

*The opening lecture by Professor Vryonis, Director of the Alexander S. Onassis Center for Hellenic Studies of New York University, was a fascinating account of the practice and progress of medicine in Mediterranean regions from antiquity to recent times. This wonderfully told story created the right atmosphere amongst the participants in the*

*meeting, and was considered a most appropriate prelude for the subsequent foundation of the Mediterranean Medical Society.*

*Herakleion, February 1991.*

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*Chairman of Steering Committee*

*Mediterranean Medical Society*

## THE MEDICAL UNITY OF THE MEDITERRANEAN WORLD IN ANTIQUITY AND THE MIDDLE AGES

**G**IVEN THE CIRCUMSTANCES OF THE PRESENT CONGRESS, that is the assembling of physicians from the Mediterranean countries for the purpose of discussing diseases and medical problems common to, or prominent in, this area, one must assume that the Mediterranean lands display a kind of medical unity. Further, the holding of such a conference on one of the principal Mediterranean islands, Crete, emphasizes the centrality of such islands in this great inland sea. Crete, Cyprus, and Sicily have, for long periods, been regions of political and cultural encounter of the various Mediterranean hinterlands.

These preliminary observations are historically so self-evident that their mere statement serves also as the demonstration of their veracity. Shared by Indo-Europeans, Semites, and Hamites from early antiquity, the Mediterranean was an area both of hostile and irenic encounters, thus engendering elements of variety and unity. The success in mastering the navigational techniques of this inland sea early made of it a culturally unifying bridge while at the same time it expanded military activities and political expansion from the land to the sea. Greeks and Phoenicians early competed for its economic exploitation. Athens first attempted to build a complex empire on it. Only the Romans ever succeeded in unifying politically the entire basin.<sup>1</sup> Though the Byzantines momentarily maintained this dominion,<sup>2</sup> it collapsed under the blows of migrating German and Slavic tribes in the west, and the rapid Muslim conquests in the east and south.<sup>3</sup> Militarily, the caliphate and the Ottomans threatened to reimpose this old Roman political unification of the area but ultimately found the task beyond their powers.<sup>4</sup> Thus, with the exception of the Romano-Byzantine interlude, the Mediterranean remained the scene of major political hostility and variety.

Though this led to a rich demographic and linguistic variety, the use of this easily navigable sea promoted, at the same time, important elements of cultural, technological, scientific, literary, and artistic interchange, often even of uniformity. Two of the three major monotheistic religions arose and grew along the Mediterranean, and the third early spread over the eastern, southern, and some northern Mediterranean shores. Though the three religions were, formally, mutually exclusive, they had certain elements of common origin and belief. In the technological realm, the area shared a common basis of technological and navigational skills. The Mediterranean basin was also the heir to many elements of Graeco-Roman society: most important were a developed urban society, a developed agricultural technology and, significantly, an important educational system. In a civilizational sense, the Mediterranean was the cradle of European civilization, whereas the Near East shared many of its elements in its own civilization.<sup>5</sup>

Nowhere is this ease of communication / transmission, and the cultural sharing of the Mediterranean basin more specifically and clearly demonstrated than in the development of medicine in antiquity and the middle ages.

All people, at whatever stages of development, evolve devices and approaches through which they deal with illnesses and wounds. At the lower stages of society, these constitute what we would today call folk medicine. This folk medicine corresponded to a developmental stage in which magic, science, and religion have not yet separated off into their respective specializations. With the progress of society, science tended to separate out this primal agglomerate and we see the emergence of clearly defined medical systems: the Chinese, the Hindu, and the Greek. For Werner Jaeger, the crucial point of emergence of Greek medicine as a science occurred at the point in time when Greek medicine was transformed into a rational system subsequent to the Ionian scientific revolution. The latter transformed the Greek way of thinking about the universe by seeking rational explanations for the phenomena of the physical world.

Only under the impact of such rationalism could medicine depart from the magma of primitive superstition. And it is to the influence of the Ionian scientific revolution that he ascribes the rise of a scientific Greek medicine, in the schools of Croton, Cnidus, and Cos.<sup>6</sup>

According to this reasoning, medicine as a scientific system arose as a Greek and Mediterranean phenomenon. I do not propose to debate here the question of the so-called 'Greek miracle' in which modern Europeans have seen their intellectual and cultural origins. It should be said at the outset, however, that the ancient Egyptian civilization, upon which the Greeks gazed with great respect and not a little awe, had witnessed a very considerable development in the practice of medicine. Greek authors as widely separated in time as Herodotus and Clement of Alexandria noted that Egyptian medicine had developed so far as to produce a very considerable specialization within its body. Herodotus had most probably visited Egypt and is very informative as to that land. Specifically in regard to the practice of medicine there, he writes:

Medicine has been divided by them according to the following categories: Each physician is a (specialist) in one illness and in no more. (...) some are set up as ophthalmologists, others as (physicians) of the head, still others are dentists, some of the middle body cavities, and others of internal illnesses.<sup>7</sup>

Even the background of the Ionian scientific revolution must be considered within the growing contact of Greek merchants, emigrants, scientists, and military mercenaries either in colonies established in Asia Minor, Syria, Egypt, and the West, or else in commercial trips and mercenary military service in these foreign lands.<sup>8</sup> In the period of the Saitic kingdom, Greek mercenaries from the Aegean world came to play a crucial role in internal Egyptian politics, and the foundation of the Greek colony of Naucratis gave the Greeks a certain access to Egyptian culture and civilization.<sup>9</sup>

It is against this background that Dr. J. B. Saunders has put forth a very interesting, and to me partially convincing, theory that the

origins of Greek medicine must include an important Egyptian component. The impact of Egyptian sculpture and architecture on early Greek art is self evident and undeniable, and it undoubtedly arose through this thickening of commercial and other relations that are in evidence from the seventh century. By the examination of the Ebers and Smith papyri of the seventeenth and sixteenth century B.C., and by a similar consideration of the so-called Chester Beatty papyrus, Saunders has demonstrated that the element of rational aetiology was not entirely absent from Egyptian medicine. Further, he discusses two medical theories which are to be traced into certain early aspects of Greek medicine. Thus, not only is there a rational element, alongside the irrational, in Egyptian medicine, but there seems to have been some channelling of Egyptian medical theories into early Greek medicine. Specifically that portion of the Smith papyrus dealing with surgery seems to have freed itself to a large extent from the magical incantations which Egyptian medicine regularly prescribed for internal illnesses. Additionally, the Beatty papyrus sees disease as a process within which one must attempt to establish the pathological interrelations as a basis for a systematic theurapeutic.<sup>10</sup>

The pathology of Egyptian medicine was based on the theory that improper digestion of food, and particularly the surfeits that remained undigested, are the causes of the diseases of the body. To this theory of superfluity as the basic aetiology of illness the Egyptians added and developed the theory of the putrefaction of this superfluity. The observative Herodotus noted this as well:

(The Egyptians) are the most learned of all people I have experienced. They live their lives in the following manner: They purge themselves three days every month, seeking health in vomitings and enemas, for they believe that all illnesses arise from the food they ingest.<sup>11</sup>

In Egyptian medical theory, this process of the corruption of the superfluity of food remaining in the body gave rise to a further ela-

boration, that is to the theory of the 'rising,' or what Greek medicine referred to as the 'flux.' This poisonous material would then rise in the body and lead to the disease.

In short, Egyptian medicine had a pathological system, with an accompanying therapeutic, which aimed at some non-religious and non-superstitious pathogenetic explanation as well as at some type of rational therapy. Traces of this overall theory are to be found in the early Cnidian school of medicine in Greece and in the large array of texts known under the name of Hippocratic Writings. But the Greek medical pathology relied, fundamentally, on a very different system, that of humours and elements. Nevertheless, we must assume that the Egyptian practice of medicine was the predecessor of the Greek in an ongoing and unbroken line of development. Further, Egyptian surgical practice accumulated a body of material, along with pharmacological data, that were in one way or another absorbed into their Greek counterparts. However, the extent and role of Egyptian medicine in the unfolding of the Mediterranean medical system must remain a mystery as we do not possess the comparatively large body of medical texts that we have for Greek and later Arab medicine.

**A**LREADY IN THE HOMERIC *ILLIAD*, the Greek *ietros* or *ieter* (from *iaomai*), the healer, appears in the personages of the two Thessalian brothers, Podaleirios and Machaon. They already enjoyed a high and privileged status in Greek society, as Idomeneus informs Nestor: "A physician is worth many men (as) he excises poison and applies mild drugs".<sup>12</sup> In this heroic society, where war, killing and wounding were frequent occurrences, the Greeks early learned to deal with such misfortunes and martial maladies.<sup>13</sup> But the first inklings of a serious development in the medical field are documented only for the sixth century and, though they appear in what is probably the first school of Greek medicine in the city of Croton, they were undoubtedly inspired by the Ionian scientific revolution. The



first Greek medical treatise, lost, was the *Peri physios* of Alcmaion of Croton. Traditionally associated with Pythagoras (himself a refugee from Ionia), Alcmaion's treatise was written in the Ionic dialect, traditional for medical texts, and reveals his investigation of the sense organs, especially the eye. His assertion that the brain was the centre of the sensory organs was of course somewhat ahead of his time. Perhaps his most interesting observation or assertion was that health was the end result of the equilibrium of forces in the human being (*isonomia dynameôn*), and disease results when the body forces become disequilibrium.<sup>14</sup> His later compatriot, Democedes, was of such renown that after his capture, along with other Greeks in Ionia, by the Persians he was summoned to the court of Darius to heal the Great King's dislocated foot. It is interesting to note that Herodotus relates that the Egyptian physicians, whom the king usually kept about him, had failed in this endeavour. After having healed the king, he became the personal physician of the king's daughter, Atossa, having healed her of a breast tumour. His position as court physician was to be duplicated later, in 417, when Ctesias of Cnidus became the physician of Darius II, Artaxerxes II, and of the queen mother, Parysatis.<sup>15</sup> This episodic information is doubly significant. First, it indicates that Greek medicine had by the sixth century begun to form as a science and had approached and even surpassed Egyptian medicine. Second, the presence of Egyptian and Greek physicians at the court of the great kings of Persia, in the great Middle Eastern hinterland, suggests that Mediterranean medicine had come to dominate not only the Mediterranean but also the Middle East, the hinterland far removed from the shores of the inland sea. This is the first, but not the last, Middle Eastern incursion of Mediterranean medicine, for the process was to be repeated in the centuries of the Muslim caliphate.

Alcmaion, Empedocles, Diogenes of Apollonia, and Democritus the atomist propounded doctrines which fit into the larger framework of Ionic nature philosophy, and as such their teachings furnished ideas, concepts, and details which the later Hippocratics and

others quarried. Particularly relevant in this respect was their promulgation of the theory that health represented a balance of power or fluids in the body, as *isonomia*, and disease an imbalance. Thus hot and cold, wet and dry, bitter and sweet, should be kept in balance. This assertion is the forerunner of the Hippocratic physiology and pathology that utilized the theory of humours. As second theory, with a medieval future, is that of *pneuma*, or air, as a dynamic or life giving principle, formulated by Diogenes of Apollonia. Democritus incorporated this latter theory in his own teaching, asserting that the *pneuma* is to be found in the human sperm, and that the soul is made up of atoms. Hampered by the lack of opportunity to carry out dissection, the anatomical concepts of the early Greek physicians remained meagre. Despite this fact Alcmaion asserted the centrality of the brain in intelligence, and the affiliation of all sense organs to it. Also with long term effects for ancient and medieval anatomical theory is the vascular system of Diogenes of Apollonia. According to him, this system hinged about two great vessels that run on either side of the spinal cord, upward to the brain and downward to the feet in the lower extremities. They carry air (and blood?). This postulation indicated clearly the groping character of much of anatomy in the teachings of the early Greek physicians. Circulation was to remain an insoluble riddle.<sup>16</sup>

Greek medicine as a coherent system with detailed and developed branches of anatomy, physiology, clinical description and pathology, regimen and therapy, surgery, and gynaecology appears in the schools of Cnidus and Cos. Indeed the latter attached a philosophical basis as well as a code of medical ethics to its medical science. Both philosophy and ethics were to remain constants throughout the history of ancient Greek medicine, and were to be taken over by the practitioners of medicine in the Islamic world. The epistemological aspects of Hippocratic medicine are revealed (in the text "*Peri technês*") in the arguments of the Hippocratics that medicine is the preserve neither of the sophists nor of nature philosophers.<sup>17</sup>

The schools of Cnidus and Cos, by virtue of their geography in the southeast Aegean, were well within focus and intensity of Ionic science. Though they were within the linguistic zone of the Doric dialect, the writings of the schools were recorded in the Ionic, a sure indication of their affiliation to the intellectual currents of the Ionic scientific revolution. Aside from surviving fragments of the Cnidian school and the massive *Corpus Hippocraticum*, we have the much later writings of Galen through which to reconstruct the medical structures of these two early schools. One of the basic differences between them was that the Cnidians were little concerned with the general theory of medicine but much more so with the specifics and varieties of each illness. Thus it is, says Galen, that the Cnidians have described seven diseases of the gall bladder, five of the foot, twelve of the urinary bladder, etc. Further, this system was diagnostic (i.e. gave detailed descriptions of the present state of the illness) rather than prognostic (attempt to foretell course of disease, its crisis and resolution) as in the case of the Coans.

Euryphon, the traditional founder of the Cnidian school, put forth a pathology that seems to be identical to that of the earlier Egyptian physicians. Disease results from the portion of indigested food that is not finally digested but putrifies and then rises to the upper parts of the body. Of undoubted interest for its enunciation of this Egyptian pathological doctrine and the diagnostic approach to pathology and therapy, the Cnidian school was quickly eclipsed by the school of Cos.

In the person of Hippocrates and in the corpus of writings that goes under his name, Greek medicine appears as a fully developed medico-scientific system that is both differentiated from philosophy and the other sciences, and from magic, superstition, incantations, and which at last is free of religion (as demonstrated by the Hippocratic text "On the Sacred Disease"). The person of Hippocrates as well as the corpus of writings attributed to him have much exercised Greek philologists and historians of Greek medicine. The most cautious have asserted that there is no sure method of deciding which

of the treatises attributed to him he actually wrote, though there is a traditional consensus. There is also a general agreement that the bulk of the *Corpus Hippocraticum* was written in the later fifth and early fourth centuries. Though the corpus includes contradictory material, there is a body within it that is in agreement with the doctrines of the Hippocratic school. According to such scholars, the corpus carried the Hippocratic name because it was originally a medical library which could have been owned by Hippocrates at the beginning. This library eventually made its way to Alexandria through the hands of the Coan physician Praxagoras. The fact that the corpus also includes texts of the Cnidians and others that are not in agreement with the Hippocratics points to a very interesting phenomenon in pre-Alexandrian medicine. The varying schools felt free to use and to apply each other's doctrines. The intolerance and polemic which beset Greek medicine in the Alexandrian age as a result of the establishment of the medical 'sects' were as yet unknown.

Anatomy and, generally, knowledge of the body were poorly known in this phase of Greek medicine as various beliefs concerning the state of body and soul after death effectively prohibited dissection. Before dissection could be employed, as in the Alexandrian period, these beliefs had to undergo radical alteration. In effect, early Greek medicine could not, therefore, be based on effective anatomical knowledge. Accordingly, we observe a strange mixture of correct observations with what seem to us curiously incorrect assertions not only in anatomy but also in physiology and in the medical functioning of the internal organs. The Hippocratic description of the bones is noteworthy, a good deal of the cardinal anatomy is correct, the pulse was known. The brain, however, was seen as the centre of the vascular system. The Hippocratics could not understand correctly the circulatory system, failed to differentiate between veins and arteries, and did not know the nervous system. The corpus itself is not consistent for we see that the text "On the Sacred Disease" reiterates Alcmaion's doctrine that the brain is the centre of sensation and intelligence. Sometimes the heart is recognized as

the centre of the vascular system. As for the vascular system, the text "The Nature of Bones" reproduces the system of Alcmaion with the two large vessels beginning above the eyes and running down to the feet. This is, however, qualified by the texts "The Nature of the Bones IX" and "The Nature of Man XI," where we read of a vascular system with four pairs of major vessels. We read of yet another version of the same system in "Bones XII–XIX," where there is only one primary vessel. They also knew the pulmonary artery.<sup>18</sup>

With this incomplete and erratic knowledge of anatomy it is no wonder that Hippocratic physicians paid little attention to the physiology of the organs in the writings of the corpus, though they were aware of some of the duties of the stomach, intestines, kidneys, and bladder. Most significant in terms of their contribution to the ongoing development of Greek and medieval medicine in the realms of physiology, pathology and therapy, are the theories of the humours and of the *pneuma*.

In the humoral theory, the Hippocratics believed that it was the humoral mixtures that resulted in the human's constitution, his temperament, his health, and that the climate and diet played important roles. These humours of ancient medicine have been compared to the secretions of duct glands which, however, play a much smaller role in modern medicine. The Hippocratic text, "The Nature of Man," describes in detail this theory which, subsequent to its later canonization, was to dominate medieval medicine in Byzantium, Islam and the medieval West. The four humours, phlegm, blood, yellow bile, and black bile, differ as to colour, warmth, coldness, dryness and moisture. Each of the four humours tends to increase in a given season: phlegm in winter, blood in spring, yellow bile in summer, black bile in autumn. Accordingly, when a given humour increases in its season, medication and treatment must be applied in order to combat the illnesses to which it gives rise. This is what has been termed the seasonal dominance of a humour, as in contrast to a more permanent temperament of a man.<sup>19</sup>

The second theory at the basis of Hippocratic physiology is that

of the *pneuma* or 'vital air.' An inheritance from the nature philosophers via Diogenes of Apollonia, its physiological importance and pathological consequences are variously explained in the texts "Airs, Waters, Places," "On the Sacred Disease," and "Breaths." In the first of these texts, it is the major vessels (what we would call the major veins and arteries) that attract most of the *pneuma* and then spread it through the body via lesser vessels, in order to cool the body, and then they exhale it (presumably through the pores of the skin). If there should be a stoppage of the air in this process the concerned part of the body is paralyzed. In the doctrine of *pneuma*, the Hippocratics approximate, and at the same time distance themselves, from the modern medical principle which attributes to air life sustenance. The Hippocratics believed that this air or *pneuma* actually is vital and bestows life on the human, bestowing intelligence on the brain and activity to the sense organs and limbs. In the text "Airs, Waters, Places," the pneumatic physiology and pathology are linked to winds which vary in heat and humidity. The text "Breaths" asserts that air is the third entity, along with food and drink, necessary for the movement of the body. It is even essential to maintaining sea life, which breaths the air contained in water. The text stresses the proposition that diseases result from air.<sup>20</sup>

The doctrine of the *pneuma* is quite strange to us, and yet the Hippocratics intimated its essence for all types of life, its effect on the brain, that somehow it is communicated to the body by the vascular system. In short, this was a crude pathological system but nevertheless one which had a rational base and which contained interesting observations and vague hints at realities.

In the realm of gynaecology, the Hippocratics knew most of the female disorders but inasmuch as they had not yet discovered the Fallopian tubes and ovaries they had not unveiled the mysteries and complications of conception.

In a day and age when the thermometer and microscope had not yet been discovered, and biochemistry with its blood, urinal, and bacteriological analyses was unknown, the Hippocratics neverthe-

less made great progress in clinical description. The books of the "Epidemics" constitute a rich mine of clinical causes with all the descriptions of symptoms of the relevant maladies: descriptions of cases of mumps, tuberculosis, malaria, fevers, blood poisoning, tetanus, wounds, empyema, and the like. The Hippocratic practice of prognosis was thus based on the accumulation and analysis of the diseases' external symptoms. The text "Prognosticon" says that the physician is to observe the features of the patient's face, his patterns of sleep, bowel movements, appetite, sweating, dropsies, urine, sputum, fever, pain, dyspnoea.<sup>21</sup>

Because the Hippocratics understood the limits of their art, their therapy was correspondingly cautious. They applied the routine of rest, comfort, washing, warming, liquid diet, and instructed physicians to look after the psychological state of their patients. They also believed that preventive medicine was more important, so that they effected or rather stressed a balance of diet and exercise. Diet was considered to be of particular importance, and the effects of various types of exercise were outlined, as was also the matter of sexual intercourse. Purges and emetics were applied but never so drastically as in Egyptian medicine. Other treatments included bleeding, draining of the lungs, though Hippocratic surgery was particularly cautious and conservative, concerning itself primarily with bones and with relieving of empyemas.

Finally, the Hippocratic school is famed for the so-called Hippocratic Oath, an oath probably taken by the young physician at the onset of his professional career. Probably composed in the fourth century B.C., it was later translated into Latin and Arabic, and eventually into modern languages.<sup>22</sup> The Hippocratic Corpus is a sizeable body of treatises and beside its plethora of anatomical, physiological, pathological and therapeutic details it reveals the emergence of Greek medicine as a secular science, based on clinical observation and philosophical (in the sense of nature philosophy) speculation. Though its fundamental physiological assumptions (humoral and pneumatic) are erroneous, still they were important graspings after

the ultimate medical relations at a time when dissection of the human body was forbidden and the medical technology for physiological and anatomical study and research were lacking.

It was this medical corpus and school which ultimately found their way to Ptolemaic Alexandria. The continuation or filiation of the Hippocratic tradition with the Alexandrian medical traditions ran through Diocles of Carystus<sup>23</sup> and Praxagoras of Cos, who continued to expound the humoral and pneumatic physiological theories. Praxagoras furthered vascular and other knowledge by differentiating between veins and arteries, and though he observed that the arteries originated in the heart he believed that they carried *pneuma* instead of blood. He further distinguished between the *neura* and the tendons. But it was his student, Herophilus of Chalcedon, who was to stand at the head of the next major advance in the medical science of the Mediterranean in the new home of Greek science, Ptolemaic Alexandria.<sup>24</sup>

Ptolemy I and his successor determined to make of their capital city a great Mediterranean centre of learning, science and medicine, and to this purpose instigated the migration of leading scholars to Alexandria. There, and under prestigious and lavish patronage, there arose the Mouseion (or Museum) with its learned scholars and scientists, its great collection of books in which the wisdom of the Greeks was recorded, and the research and teaching of the assembled scholars.<sup>25</sup> The Hippocratic Corpus quickly made its way to Alexandria, and Ptolemy recruited the physicians Herophilus and his student, Erasistratus of Iuli, both products of the Coan school. Thus the centre of medical research shifted from the northern shores of the Mediterranean to the original historical site of this medical tradition, Egypt. Alexandria was to remain the medical centre of the Mediterranean down to the Arabic conquest in 641–42, at which time the Greek physician Paul of Aegina was teaching and practising medicine in Alexandria.<sup>26</sup>

The determination of a rich and powerful state, such as that of the Ptolemies, to support medicine was, of course, an under-



standable spur to further development of this science. At the same time, certain changes within Greek philosophy had occurred as to how the human body after death was viewed. Originally, the belief prevailed that the defunct body still retained some sense of harm that might befall it, and thus it was not to be damaged (cremation?). Plato had put forward the contrary idea that the soul was immortal and utilized the body only during life, discarding it after death. Aristotle alleged that after death the body had no feeling and therefore no claims. Thus, it has been alleged by some modern scholars that by the end of the fourth century the older inhibition against mutilation of the body through dissection had sufficiently weakened to prepare the way for the practice of dissection.

If this be the case philosophy was in part responsible for the next significant advance in medicine, for the Alexandrians, particularly Herophilus and Erasistratus, practised dissection of the human cadaver. If we are to believe the later testimony of Celsus, Herophilus carried out vivisection as well, on criminals, a cruel practice which Celsus attempted to justify. Herophilus identified the Fallopian tubes and ovaries, and so it is not surprising that he enjoyed fame as an obstetrician. He identified the duodenum, the salivary gland, the glands leading from the stomach into the entrails, the discharge of bile from the liver. He formulated the sub-specialty of sphygmology. He seems to have advanced knowledge in the physiology of the human nervous system. Neura, according to Herophilus, were like the sinews but they actually began in the head either in the fourth ventricle of the brain or in spinal marrow, and deployed throughout the body. They did so and also transmitted pneuma. He understood that certain paralyses in the nervous system brought about the loss of sensation, others resulted in loss of movement, and still others caused both.<sup>27</sup>

Erasistratus carried on in the tradition of Herophilus, on the one hand, in anatomical studies where he continued dissection, and carried out studies in the comparative anatomy of men and animals. This led to his formulation of the teaching of the *triplokia tôn an-*

*geiôn*, to wit that each organ possesses an accompanying 'threefold network' of vein-artery-nerve. In studying the brain, he identified the greater brain (*cerebrum*) and the lesser brain (*cerebellum*). He observed that the brain was covered by membranes (*mêninges*). He attributed to the highly curved and furrowed nature of the human brain man's intelligence superiority over the animals. He, of course, underlined the centrality of the brain for the system of *neura*.

Certainly, his most startling innovation lay in his physiology. He rejected completely the Hippocratic humoral physiology, never mentioning black bile in his writings. Unfortunately for medicine, his rejection of the Hippocratic humours as useless did not prevail, for when Galen finally established an 'orthodox' physiology he canonized the Hippocratic humoral theory. Erasistratus made a second physiological innovation by replacing the humours with the Democritan atoms while retaining the older theory of the *pneuma*. Though he acknowledged the difference between veins and arteries in his vascular system, he believed as Herophilus that blood coursed through the veins and *pneuma* through the arteries. In its diastolic action, the heart drew these two substances into the appropriate cardiac ventricles. Through its systolic movement, blood was sent through the veins to the lungs and *pneuma* via the aorta into the arteries. He associated the system and process of digestion with the course of the blood. As the food proceeded to the stomach, it was kneaded by peristalsis in the stomach and then, in liquid form, it was forced into the blood vessels and into the liver, where it was transformed into blood.<sup>28</sup>

The superior anatomy of Herophilus and Erasistratus, and the rejection of the humoral theory by the latter, seemed to prepare the Alexandrian physicians for further major advances in their science. But the eventual resurgence of the humoral theory and the development of a kind of medical orthodoxy put an end to the more adventurous spirit and to any further revolutionary advance. We must also keep in mind the undeveloped state of medical technology. The remaining history of Greek medicine down to the dominant figure of

Galen is marked by two developments. First is the rigidification of the medical field by the formation of what has been called medical sects: Galen refers to them as the Dogmatists (4th c.); the Empiricists (who, commencing with Philinus, violently attacked the theoretical or speculative practice of medicine); the Methodists (Themison and Soranus, who sought a middle way between Dogmatists and Empiricists); and the Pneumatists (Athenaeus of Attaleia and Aretaeus, who put new emphasis on the doctrine of *pneuma*). The polarized nature of much of the spirit of these later medical sects tended to limit the creative use of the vast and non-cohesive body of Greek medical theory, practice and literature.<sup>29</sup>

The second development, which was a consequence of this restlessness as well as of the vastness of Greek medical theory and texts, was the movement to codify, a movement which culminates in the work of the great physician Galen in the second century A.D. Galen was, by the standards of ancient and medieval medicine, an all-encompassing intellect, and as such was the best student and interpreter of the whole development of Greek medicine. The form which the continuity of ancient medicine took in the medieval world thereafter is, in the first instance, due to the choices, evaluations, and writings of Galen.<sup>30</sup>

The number of medical treatises attributed to him surpasses 130 (in the edition of Kühn), plus the works attributed to him and which have survived only in Arabic. This formidable oeuvre, twice as great as the surviving *Corpus Hippocraticum*, has been divided into seven categories: anatomy, pathology, therapy, diagnostic and prognostic, the commentaries on Hippocrates, philosophy, grammar. Though he wrote no specific work dedicated to physiology and surgery, they are nevertheless fully and copiously discussed and described in the works listed under the above seven categories. The strong philosophical spirit that pervades his work is illustrated by the book "That the best Physician is also a Philosopher," and Galenic medicine was to carry with it a strong philosophical underpinning. On the other hand, his work "On Medical Experience," which is in the form of a

dialogue between Empiricists and Dogmatists, does not take sides in the quarrel between the champions of theory and experience. In effect, Galen seems to have sided with experience but without abandoning theory.

Galen sanctified the humoral approach of the Hippocratics, thus perpetuating it into late Byzantine, Arab and Latin medicine, in the realms of physiology and pathology. The biles, blood and phlegm were thus to have long medical careers. Though he was conservative in the application of surgery, he continued to practise vivisection on animals with the purpose of gaining a greater knowledge of neurology. Indeed, he made a significant find when he stated that both veins and arteries carried blood, but this too fell short of the discovery of the circulation of blood. In effect, Galen, by his mastery of the entire field of Greek medicine, was able to review the legacy and to select that part of it which was to live on in his own great canon of Greek medicine.

**I**N THE BYZANTINE PERIOD, Alexandria remained the centre of medical practice teaching and writing, and most of the famous physicians studied, and/or practised, there up until the fall of the city to the Arabs. The most famous of these physicians and scholars included Oribasius,<sup>31</sup> physician to the emperor Julian, Aëtius of Amida,<sup>32</sup> and Paul of Aegina.<sup>33</sup> The one important exception seems to have been the sixth century physician Alexander of Tralles who, before settling down in Rome, travelled through much of the western Mediterranean.<sup>34</sup> Though these physicians, and other Alexandrian doctors as well, actually practised medicine (that is, they were not merely cook-book physicians), in their written work they were essentially epitomators of the ancient medical tradition and texts. The role of Alexandrian scholarship more generally had come to consist of a massive excerpting from the ancient corpus of Greek writings so as to make Greek culture more easily available to the schools in convenient encyclopedias. This is perhaps most striking-

ly evident in the fate of the corpus of the great Athenian dramatic poets, surviving in only a small portion of its entirety. A similar process was now applied to the large body of medical texts. The result in medicine was that the Alexandrian school curriculum was reduced to a selection of twelve Hippocratic and sixteen Galenic texts, the numerical proportions seem to have survived through the Syriac schools or through the texts into Islamic translational and medical literature. Thus the literary labour of the above named Alexandrian physicians was essentially that of the compiler, epitomator, and scholiast. Manuscripts of many of the original and unsummarized works were still available at the time that the epitomes were circulating. But more and more epitomes came to represent the current medical curriculum.<sup>35</sup>

Though Greek medicine had begun to spread to Rome by about 200 B.C., it originally aroused the distrust of the old aristocratic class. Nevertheless,<sup>36</sup> medicine in the western Mediterranean was essentially Greek medicine, and the doctors from the eastern Mediterranean retained their prestige position in the field.

The figure of Paul of Aegina is symptomatic of the fate of Greek medicine in the Mediterranean during the Middle Ages. He was actively practising, teaching, and writing about medicine at that time when the Arabs conquered and occupied Egypt. This indicates that late ancient medicine was alive and active, and there is no indication that the tradition was destroyed by the Muslim conquerors. The traditional study of Greek learning not only seems to have survived in Umayyad Alexandria but to have moved to Antioch in 718, with some of its manuscripts ultimately making their way to Baghdad. The continuation of the pursuit of Greek learning and medicine in Umayyad Alexandria not only tells us something significant about the survival of Greek learning, but it points to yet another phenomenon. At the time of the Arab conquests, Galenic medicine was being taught in some of the Syriac schools and was being practised in much of the Near East by the older Syriac, Greek, Persian and Jewish physicians. Decisive was the nature of the Christian school tradition

which had adopted the curriculum of the late ancient school of Alexandria. Thus the Syriac schools continued to cultivate the Greek language and literature, especially Aristotle, Porphyry, the mathematical and scientific texts, and the medical tradition of Galen. Important in the fixing of a Syriac Galen were the translations of Sergius of Ras al-Ayn (d. 536), who rendered Aristotle's "Categories," Porphyry's "*Eisagoge*" and much of Galen into Syriac. Simultaneously, he gave birth to the Syriac school of medicine which ultimately produced and culminated in Hunayn ibn Ishaq.<sup>37</sup> In Persia, Gondeshapur, a foundation of the Sassanid monarch Shapur who settled Greek prisoners there, eventually flowered as a centre of Galenic medicine in the hands of the city's Syriac, Nestorian, Christians. The pre-eminent Christian family of the city, the Bukhtishus, were to play a dominant role in the teaching of medicine there, as directors of the hospital of Baghdad, and as court physicians.<sup>38</sup>

Thus, not only did Greek medical science survive in Muslim Egypt, Syria, Mesopotamia and Iran, but the Muslim rulers eagerly embraced it in the ninth century. Cultural diffusion is most often a functional phenomenon. A given society borrows cultural elements because these elements correspond to a need. The caliph al-Mamun and the court circle welcomed the Greek medicine, which they found among their Syriac Christian subjects, because they believed that it had obvious and practical advantages. Thus al-Mamun founded the bayt al-hikma in Baghdad, and richly endowed it, so that these Syriac scholars and physicians could collect the Greek manuscripts, translate them, study them, and make their benefits available to the caliph and his circle.<sup>39</sup>

The crucial personality and the most brilliant light in this sudden movement to translate the Greek texts into Arabic was the Syriac speaking (but Arab) Christian Hunayn ibn Ishaq (808–73). We know a good deal about him but will note here only his role in the study and translations of the Greek medical texts. Because of his prominence in the field of medicine he was appointed court physician to the caliph al-Mutawakkil (847–61), and was closely associ-

ated with the powerful members of the court. Most interesting is the person of Ali ibn-Yahya ibn-al-Munajjim, the son of the court astrologer, who commissioned Hunayn and his assistants to translate ten of Galen's works for him. In his letter to Ali ibn-Yahya, Hunayn lists, and gives the contents of, 129 of Galen's texts that had been translated from Greek into Syriac and Arabic.<sup>40</sup> One is astonished at how quickly the body of Galen's texts made its way into Arabic and thereby became available to all those Arabs who could not read Greek. This sudden 'arabization' of Galen corresponds with the rapid rise of a brilliant Islamic tradition of medicine. Far behind Galen in popularity were the texts of the Hippocratic Corpus. Arab pharmacology eagerly absorbed the "*Materia Medica*" of Dioscurides, translated by Istafan ibn Basil and improved by Hunayn himself. At least 58 treatises of Rufus of Ephesus were translated into Arabic from Greek, as were lesser numbers of writings of Philagrius, Crito, Antyllus.<sup>41</sup> Despite the translations of such a large number of individual works, the great Islamic medical encyclopedists relied on the Arabic translations of the four great Byzantine compilers: Oribasius, Aëtius, Alexander and Paul of Aegina. Ar-Razi, at-Tabari, al-Majusi, Ibn Sina, az-Zahrawi, all found these compilations more convenient for their purposes as they were neatly structured, less contradictory, and certainly less massive than the great Hippocratic or Galenic writings. In mining these Byzantine compilers, they also adopted their literary structure and form. Thus the Islam physicians and scholars came to know of Erasistratus, Herophilus, Diocles, Athenaeus and others, in this indirect manner through the Byzantine medical compilations.<sup>42</sup>

Analyses of at-Tabari's "Firdaus kitab al-Hikma," Ibn Sina's "Qanun",<sup>43</sup> az-Zahrawi's chapter on surgery in the "Kitab at-Tasrif," ar-Razi's "Kitab al-Mansrui," and al-Majusi's "Kitab al-Malaki," have shown clearly the profound consequences of Muslim contacts with Mediterranean medicine. The physicians of the Islamic world, whether Arabs, Persians, or Jews, repeated "the thoughts of the Greeks, and collected and amassed what had been

handed down. This effort reached its peak in the encyclopedias (...) left us by ar-Razi, al-Majusi, az-Zahrawi, Ibn Sina and others. What they offer us is not factual material extracted through observation based on theories. These theories were once formed by the Hippocratics and the Alexandrian doctors right down to Galen in the area of tension between philosophical theorems and the appearances of the healthy and unhealthy human organism. They are therefore genuine science".<sup>44</sup>

This Islamic medicine reveals its Mediterranean origins in its physiology, anatomy, pathology, dietetics, and pharmacy, all of which are entirely those selected and cononized by Galen: The humoral physiology with the four elements, the temperaments and the four humours; to this is added the doctrine of the pneumata (natural, animal, psychic). Digestion and circulation are also largely Greek. Anatomy is clearly that of Galen. In pharmacology, the authority was again Galen's choice, Dioscurides.

Thus, the Mediterranean medical tradition was, via Islamic civilization, developed in the hinterland of the Middle East, and thence carried by Islamic civilization across Syria, Egypt, North Africa, and into Spain.

Whereas the Hippocratic / Galenian tradition had maintained itself in Byzantium and the Islamic world, the science and practice of medicine drastically declined in the medieval western Europe. Scattered manuscripts of Latin translations of Greek medical texts still existed and have now been identified, but the low level of this weakened Galenian tradition can be seen in the works of the seventh century author Isidore of Seville.<sup>45</sup> In the eleventh and twelfth century, however, the Galenic medical tradition, in its Arabic form, returned to Latin culture as a result of the activities of translators in eleventh-century Italy and twelfth-century Spain. Constantine Africanus, after having studied Arabic medicine in eleventh-century Tunis, spent the rest of his life in Montecassino translating Arabic medical texts, including the "Kitab al-Malaki" of al-Majusi, into Latin.<sup>46</sup> More fruitful ground for these activities, however, was the city of



Toledo, reconquered from the Arabs in 1085. Its twelfth-century archbishop, Raymond, created an important intellectual and translation centre in the city with the view of translating into Latin the great works of the Islamic philosophers, scientists and physicians. It was here that Gerard of Cremona busied himself in translating the three great medical encyclopedias of ar-Razi, az-Zahrawi, and Ibn Sina, from Arabic into Latin.<sup>47</sup> Thus Greek medicine, alongside Aristotle, was reintroduced into Latin Europe via this long, circuitous route from Arabic: Alexandria, Antioch, Baghdad, North Africa, Italy, and Spain. This newly introduced 'Arabic' medicine was to dominate the field in Europe until Paracelsus, Vesalius and Harvey were to destroy its basis by the new scientific medicine.

We have come a long way from the origin of Mediterranean medicine in Egypt, its first full fledged scientific development in the hands of the Greeks, its development and transmission by the Arabs to western Europe in the middle ages. Throughout this long period, its origins and mainsprings, as well as much of its diffusion, were Mediterranean.

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